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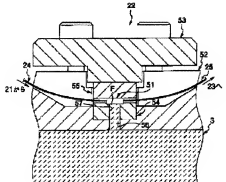
(54) **LIQUID ANALYZING PRISM UNIT WITH INFRARED RAY FEEDING INFRARED FIBER**

(57) Abstract:

PROBLEM TO BE SOLVED: To provide a prism unit capable of surely receiving and radiating infrared rays in spite of being a small attenuation total reflection(ATR) prism.

SOLUTION: This prism unit 22 having an ATR prism 51 reflecting the fed infrared rays on the surface of a liquid with which the prism 51 is in contact, is provided with a feeding infrared fiber 24 feeding infrared rays to the ATR prism 51 and a receiving infrared fiber 25 receiving the reflected infrared rays. When the infrared rays from a light source are transmitted by the feeding infrared fiber 24 and cast on a small prism from the feeding infrared fiber 24, the infrared rays are surely fed to the ATR prism 51 from a small specific point on the prism. The infrared rays reflected on the boundary surface F are surely extracted from the specific point of the ATR prism 51 by the receiving infrared fiber 25. The prism unit 22 can be enhanced in the constituent analysis accuracy and measurement accuracy of a liquid analyzer.



DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]Infrared rays are used for this invention and it measures analysis of the ingredient of fluids, such as liquefied foodstuffs and liquefied chemicals, and/or the concentration of a fluid (in this specification.). Analysis and density measurement of an ingredient are only collectively called "analysis". It is related with the ATR (Attenuated Total Reflection: attenuated total reflection spectroscopy) prism unit used in a fluid analysis apparatus. An ATR prism is only hereafter made to call "prism."
[0002]
[Description of the Prior Art]This kind of fluid analysis apparatus enters conventionally the prism which the infrared rays emitted by a light source unit were formed in the prism unit, and contacted the fluid sample, A fluid is analyzed by making it reflect in an interface with a fluid sample, receiving light with a light-receiving unit, and detecting the output of the infrared rays of the wavelength which was able to be weakened among the infrared rays reflected in the interface with a fluid sample.
[0003]In this case, after it is condensed by the position on the prism of a prism unit and the infrared rays emitted by a light source unit pass prism with beam condensing units formed in the light source unit, such as a lens, a mirror, and a slit, it is condensed again and they are received by the light-receiving unit.
[0004]A fluid analysis apparatus may be used for the component analysis and density measurement of a liquefied eating-and-drinking article. In this case, since a prism unit is dipped in a liquefied eating-and-drinking article, with the antibacterial, prism must be disinfected periodically and must always be kept clean. So, it is necessary to use the substance excellent in the corrosion resistance which is not invaded by the antibacterial for prism.
[0005]
[Problem(s) to be Solved by the Invention]However, the prism unit of such a fluid analysis apparatus has the following problem, in order to receive the infrared rays condensed by a

lens, a mirror, slit, etc. by prism.
(1) It is difficult to receive infrared rays at the specific point on prism.
(2) After entering into prism, it is still more difficult to take out the infrared rays emitted from the specific position on prism.
(3) Since incidence and extraction of infrared rays are difficult, the analysis accuracy or density measurement accuracy of a fluid analysis apparatus cannot be raised.
(4) Incidence and extraction of infrared rays become difficult, so that a prism unit is separated from a light source unit or a light-receiving unit. For this reason, a prism unit cannot be used at the place distant from the light source unit or the light-receiving unit.
[0006](5) Since it is necessary to use the substance excellent in the corrosion resistance which is not invaded by the antibacterial for prism, it is possible to use a diamond, sapphire, etc., but while excelling in corrosion resistance, since it is expensive, a diamond, sapphire, etc. must be formed small. However, the problem that incidence and extraction of infrared rays become difficulty further for prism to be small arises.
[0007]Even if the purpose of this invention has small prism, while being able to receive infrared rays certainly at the specific point on prism and being able to emanate to a light-receiving unit certainly, It is in providing the prism unit for fluid analysis apparatus which can be used at the place distant from the former from a light source unit or a light-receiving unit.
[0008]
[Means for Solving the Problem]In a prism unit for fluid analysis provided with an ATR prism made to reflect infrared rays with which this invention entered in an interface with a fluid of a measuring object which contacted, Said technical problem was solved by a prism unit for fluid analysis provided with an infrared fiber for incidence which enters said infrared rays in said ATR prism, and an infrared fiber for light-receiving which receives said reflected infrared rays.
[0009]
[Function]The infrared rays emitted from the light source enter into the infrared fiber for incidence. The infrared rays which entered into the infrared fiber for incidence are guided to a prism unit, and are entered in the end of prism at a fixed angle to prism with the infrared fiber for incidence. Since the end of the infrared fiber for incidence is sticking or approaching prism at this time, infrared rays are certainly entered in the specific point on prism.
[0010]The infrared rays which entered into prism are reflected in an interface with the fluid sample with which prism is in contact. When infrared rays reflect, the infrared rays of a certain specific wavelength are absorbed by the specific ingredient in a fluid sample, and are attenuated.
[0011]Then, both the infrared rays of the attenuated specific wavelength and the infrared rays of the wavelength which is not decreased are emitted from the other end of prism, and enter into the infrared fiber for light-receiving, and it is shown even to a light-receiving unit

to them. Since the end of the infrared fiber for light-receiving is sticking or approaching prism at this time, infrared rays are certainly emitted to the infrared fiber for light-receiving from the specific position on prism. At the end, the output of the infrared rays of the decreased wavelength is detected, and component analysis of a fluid sample and density measurement of a fluid are performed.

[0012]

[Example]Hereafter, the example of this invention is described based on drawing 1 thru/or drawing 9. The fluid analysis apparatus 20 whole is explained based on drawing 2. The fluid analysis apparatus 20 is mainly constituted by the light source unit 21, the prism unit 22, and the light-receiving unit 23. The prism unit 22 is in contact with the fluid sample S used as the measuring object of an ingredient and concentration. The three units 21, 22, and 23 are connected with the infrared fibers 24 and 25. The infrared rays emitted by the light source unit 21 are transmitted to the prism unit 22 with the infrared fiber 24 for incidence, and are transmitted to the light-receiving unit 23 with the infrared fiber 25 for light-receiving from the prism unit 22 after that.

[0013]Infrared wavelength is about 2 thru/or 25 micrometers. The construction material of the infrared fiber 24,25 is chalcogen-ized glass (As-Se-Te), silver halide (AgCl:AgBr), and zirconium fluoridation, anhydrous quartz, etc. The diameters of the infrared fibers 24 and 25 are about 0.25 thru/or 1.5 mm, and length is about 1 thru/or 5 m.

[0014]The light source unit 21 is explained based on drawing 3 thru/or drawing 6. As shown in drawing 3, the light source unit 21 is mainly constituted by the heater 31, the lens 32, the slit 33, and the chopper 34. The Nichrome wire or tungsten wire (graphic display abbreviation) coiled spirally is used for the heater 31. The heater 31 emits light in the infrared rays of the broadband which has about 2 thru/or the wavelength of 25 micrometers, when heated by about 600 thru/or 1000 **. The heaters 31 may be a ceramic heater (graphic display abbreviation) or the light source of the other type which emits infrared rays, for example, a high-pressure mercury-vapor lamp, and infrared laser.

[0015]The heater 31 is surrounded and protected by the casing 37 which comprised the metal container liner 35 and the outer case 36. Between the container liner 35 and the outer case 36, the cooling water W which prevents heating of the casing 37 flows.

[0016]The infrared rays emitted from the heater 31 enter into the lens 32, as the optical path A shows, as the optical path B shows with the lens 32, it is condensed, and they are entered in the infrared fiber 24 for incidence. In this case, the infrared rays which passed the center of the lens 32 are cut by the main shade part 38 of the slit 33 when condensed by the infrared fiber 24 for incidence. This is for carrying out that give and enter a certain angle in the prism 51 (refer to drawing 1 and drawing 8) built in the prism unit 22 which mentions infrared rays later to the major axis direction of the prism 51, and it is easy to reflect it on a fluid sample S side.

[0017]When the infrared rays which passed the center of the lens 32 are temporarily entered in the infrared fiber 24 for incidence, the infrared rays, The prism 51 is passed

without entering into the prism 51 at the angle of about 0 times to the major axis direction of the prism 51, and reflecting on a fluid sample S side, Other infrared rays reflected on the fluid sample S side are weakened, and it becomes the cause of reducing the analysis accuracy of the ingredient in the light-receiving unit 23, and the density measurement accuracy of a fluid.

[0018]Infrared rays enter into the infrared fiber 24 for incidence, after becoming irregular so that the strength of light may arise at a fixed interval with the chopper 34 mentioned later in order to reduce the influence of the stray light (optical noise) by post-processing. The construction material of the lens 32 is calcium fluoride, ZnSe, germanium, sapphire, barium fluoride, a single crystal of KRS-5, a semi- single crystal, etc. The diameters of the lens 32 are about 2 thru/or 100 mm. Instead of the lens 32, the concave mirrors, an elliptic mirror, a parabolic mirror, etc., 39 and 39 of two sheets may be opposed, it may be used in the state, and the infrared fiber 24 for incidence may be made to condense infrared rays, as shown in drawing 5.

[0019]It has the chopper 34, it is formed in the axis of rotation 41 (refer to drawing 3) of the drive which is not illustrated, and two or more infrared pass holes 40 by which it is formed radiately and through which infrared rays pass are rotated, and it makes infrared rays produce the strength of per second 12.5 times of lights, as shown in drawing 6, for example. When it does not need density measurement accuracy that it is not necessarily required and highly precise, it is not necessary to form the slit 33 and the chopper 34.

[0020]The prism unit 22 is explained based on drawing 1, drawing 7, or drawing 9. The prism unit 22 is mainly constituted by the prism 51, the prism case 52, and the prism presser-foot flange 53. The prism 51 is put between the sample packing 54 and the prism packing 55 so that the fluid sample S may permeate into the prism case 52 and it may not turn to the back of the prism 51. One side of the prism 51 is countered and the fluid sample penetration holes 56 and 57 are formed in the prism case 52 and the sample packing 54. The fluid sample penetration holes 56 and 57 are formed in order to draw the fluid sample S and to make one side of the prism 51 contact.

[0021]The construction material of the prism 51 is a diamond, sapphire and silicon excellent in corrosion resistance, ZnSe, polyethylene, etc. The prism 51 is formed in comparatively small discoid or rectangular shape a diameter or whose length of one side is about 2 thru/or about 30 mm. When formed in rectangular shape, it is necessary to cut an entrance plane (end face of prism) into about 30 thru/or 60 degrees to the major axis direction of the prism 51 so that infrared rays may enter easily. When the prism 51 is cut, 0 thru/or 70 abbreviation needs to lean the object for incidence, and the infrared fibers 24 and 25 for light-receiving, and it is necessary to install them to the major axis direction of the prism 51, according to the construction material of the prism 51, and the physical properties of the fluid sample S. Resin fluoridation, silicone rubber, etc. excellent in corrosion resistance are suitable for the construction material of the sample packing 54 and the prism packing 55.

[0022]The inside of the infrared rays transmitted with the infrared fiber 24 for incidence from

the light source unit 21, Since it is cut into the slit 33 in the light source unit 21 to the major axis direction of the prism 51 by the main shade part 38 of the slit 33 which shows drawing 3 and drawing 4 the infrared rays of the direction of about 0 times, it is transmitted to it in the state where it dimmed. For this reason, as shown in drawing 8, almost all the infrared rays that enter into the prism 51 maintain a certain angle to the major axis direction of the prism 51, and enter into the prism 51.

[0023]Total internal reflection of the infrared rays which entered into the prism 51 is carried out to the prism 51 in the interface F with the fluid sample S. The infrared rays of a specified wavelength are attenuated in the interface F among the infrared rays which carried out total internal reflection by the specific component in the fluid sample S according to the concentration of a specific component. Thereby according to the specific component in the fluid sample S, and concentration, the infrared rays of a specified wavelength enter into the infrared fiber 25 for light-receiving which is emitted from the prism 51 in the state where it dimmed, and faces to the light-receiving unit 23 with the infrared rays of the wavelength which is not dimmed.

[0024]Although the fluid sample S touches one side of the prism 51, the prism unit 22 shown in drawing 1 and drawing 7, Since the prism unit 122 shown in drawing 9 counters both sides of the prism 51 and has formed the fluid sample penetration hole 158,159,156,157 in the prism presser-foot flange 153, the prism packing 155, the prism case 152, and the sample packing 154, The fluid sample S can touch both sides of the prism 51, and the rate of the infrared rays which carry out total internal reflection to the prism 51 among the infrared rays which entered into the prism 51 in the interfaces F and F with the fluid sample S can be doubled.

[0025]This prism unit 122 can also be made to emit from the prism 51, after the infrared rays of a specified wavelength have dimmed according to the specific component in the fluid sample S, and concentration rather than the prism unit 22 shown in drawing 1 and drawing 7. Therefore, the prism unit 122 shown in drawing 9 can raise the analysis accuracy and density measurement accuracy of a fluid analysis apparatus rather than the prism unit 22 shown in drawing 1.

[0026]By the light-receiving unit's 23 receiving the infrared rays sent from the prism 51 with the infrared fiber 25 for light-receiving, and detecting the output of the infrared rays of the wavelength decreased among the infrared rays, While analyzing the ingredient of the fluid sample S, it is a unit which can measure the concentration of a fluid.

[0027]Next, operation is explained. After the infrared rays emitted from the heater 31 which is a light source are cut in part by the slit 33, it is condensed with the lens 32 and they are entered in the infrared fiber 24 for incidence.

[0028]The infrared rays which entered into the infrared fiber 24 for incidence are transmitted to the prism unit 22 with the infrared fiber 24 for incidence, and are entered in the end of the prism 51 at a fixed angle to the prism 51. Since the end of the infrared fiber 24 for incidence is sticking or approaching the prism 51 at this time, infrared rays are

certainly entered in the specific point on the prism 51.

[0029]Infrared rays are reflected in the interface F of the prism 51 and the fluid sample S. While reflecting, the infrared rays of specific wavelength are absorbed by the specific ingredient in the fluid sample S, are decreased, and are emitted from the other end of the prism 51 with the infrared rays of other wavelength.

[0030]The infrared rays which you were made to emit from the prism 51 enter into the infrared fiber 25 for light-receiving, and are sent to the light-receiving unit 23. Since the end of the infrared fiber 25 for light-receiving is sticking or approaching the prism 51 at this time, infrared rays are certainly emitted to the infrared fiber 25 for light-receiving from the specific position on the prism 51. By investigating the output of the infrared rays of the wavelength decreased among the infrared rays sent to the light-receiving unit 23, the ingredient of the fluid sample S is analyzed or the concentration of a fluid is measured.

[0031]Thus, the infrared rays which enter into the prism 51, When it is transmitted with the infrared fiber 24 for incidence and emanates on the prism 51 from the infrared fiber 24 for incidence, it becomes the radiation from a very small point, and is entered in the prism 51 from the specific point on the prism 51. It is taken out from a specific point of the radial plane of the prism 51 with the infrared fiber 25 for light-receiving.

[0032]Therefore, even if the prism 51 is small, while being able to enter infrared rays correctly from the specific point on the prism 51, infrared rays can be made to be able to emit from the specific point on the prism 51, and the component analysis accuracy and density measurement accuracy of the fluid analysis apparatus 20 can be raised.

[0033]The infrared rays emitted by the light source unit 21 are transmitted with the infrared fiber 24 for incidence, and the infrared rays emitted from the prism 51 are transmitted even to the light-receiving unit 23 with the infrared fiber 25 for light-receiving. For this reason, the prism unit 22 can be used at the place distant from the light source unit 21 and the light-receiving unit 23.

[0034]

[Effect of the Invention]In order to guide infrared rays with an infrared fiber according to the prism unit for fluid analysis apparatus of this invention, Even if prism is small, while coming to be able to perform easily entering infrared rays in the specific point on prism, infrared rays can be made to emit easily from the specific position on prism, and it becomes like. When infrared incidence and radiation become easy, even if prism is small, the analysis accuracy of a fluid analysis apparatus and the accuracy of measurement can be raised. A prism unit can be used in the place separated from the light source unit and the light-receiving unit rather than before by guiding infrared rays with an infrared fiber, The component analysis work of the fluid sample by a fluid analysis apparatus and the density measurement work of a fluid can be done now at a desired place.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1]A prism unit for fluid analysis provided with an ATR prism made to reflect infrared rays which entered in an interface with a fluid of a measuring object which contacted characterized by comprising the following.
An infrared fiber for incidence which enters said infrared rays in said ATR prism.
An infrared fiber for light-receiving which receives said reflected infrared rays.

[Translation done.]